Linking Sea Ice Physical Properties with Under-Ice and In-Ice Ecosystems

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ARK-XXVII/3 (IceArc)
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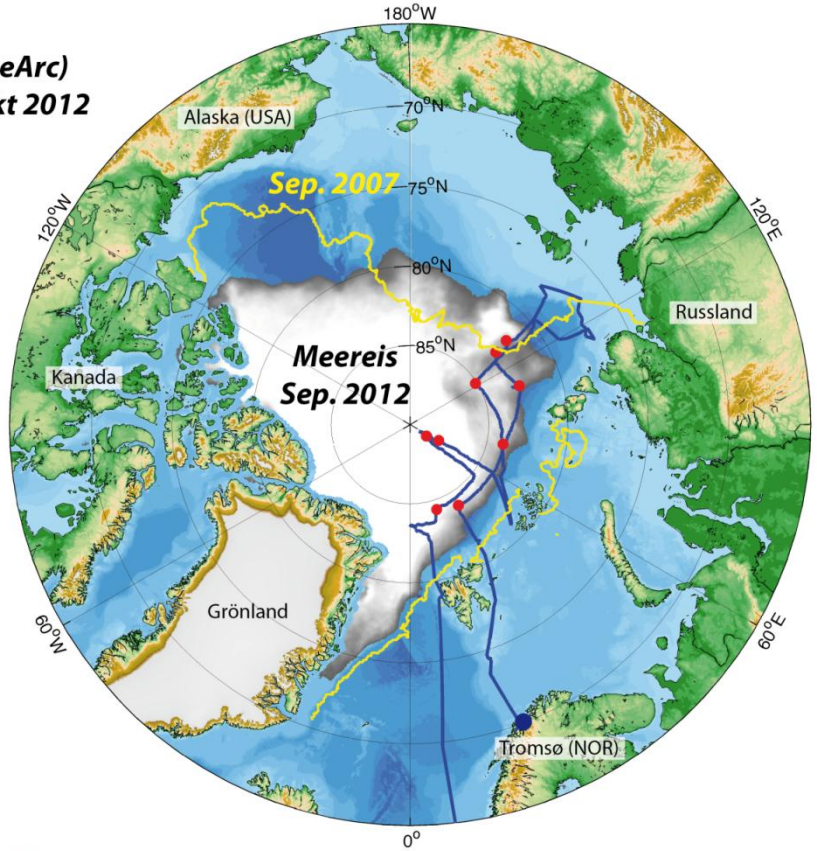

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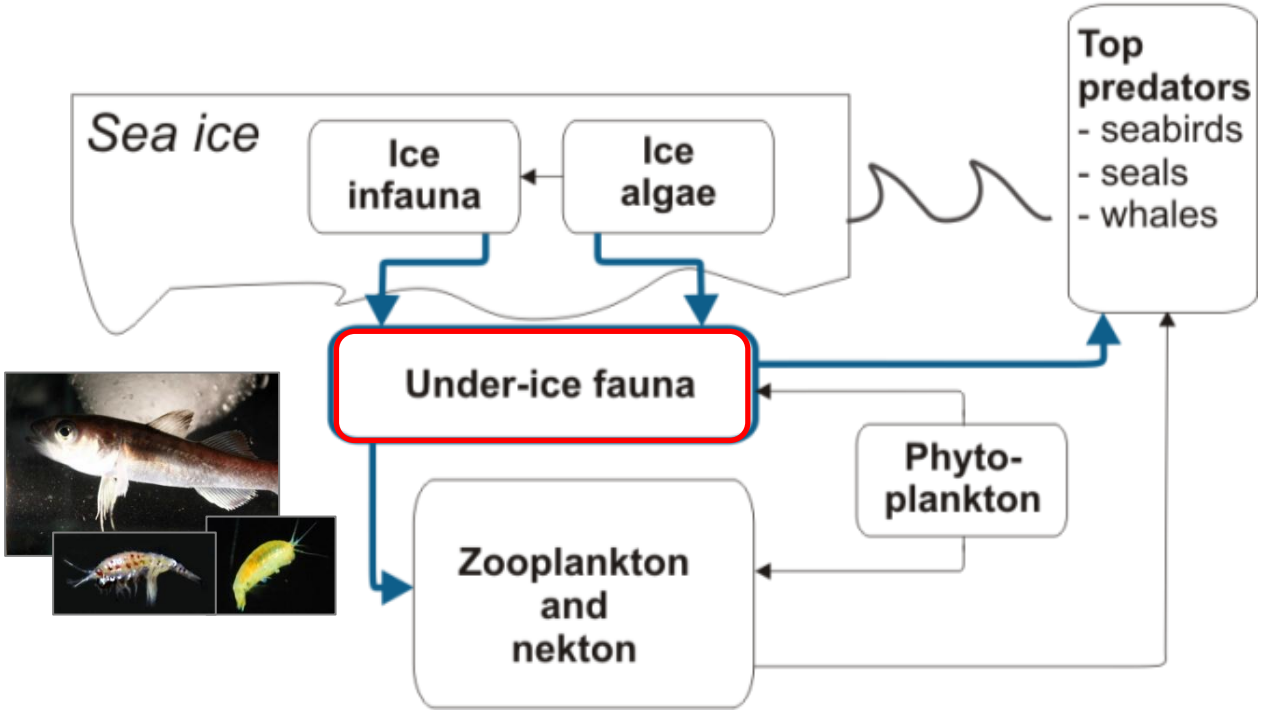
Iceflux objectives

» Characterize Physical environment

» Identify/Characterize Under-ice communities » key species

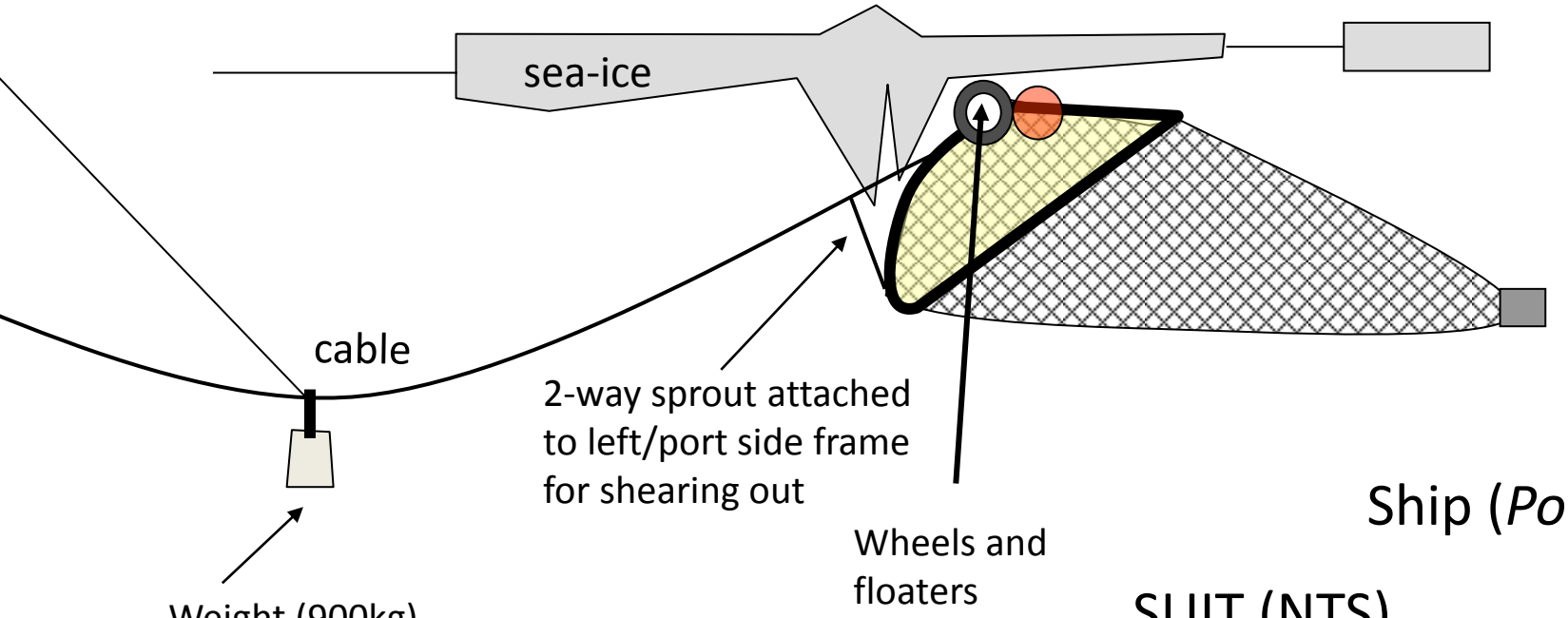
» Link physical habitats with communities

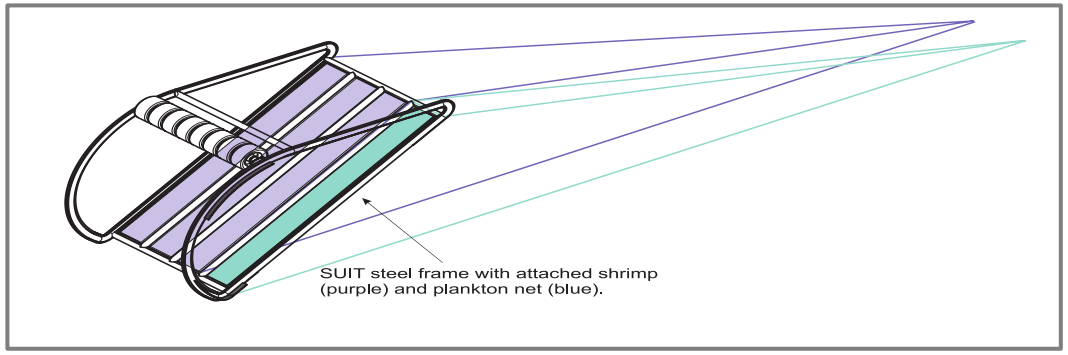
» Biota – environment interactions (modeling - postdoc TBD)



Carbon flux through sea ice food web

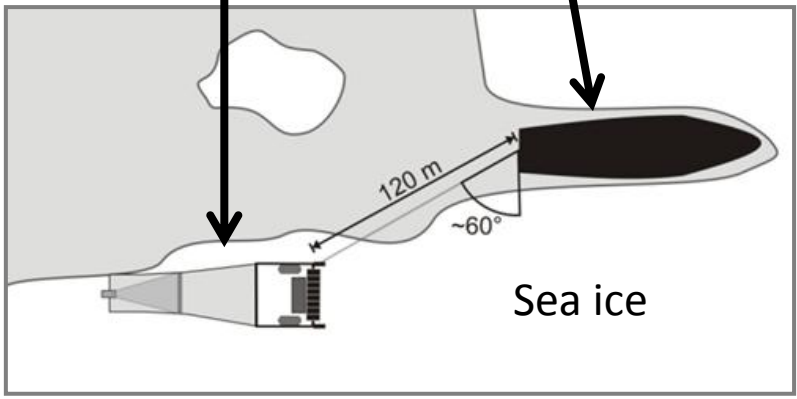
Surface & Under Ice Trawl (SUIT)



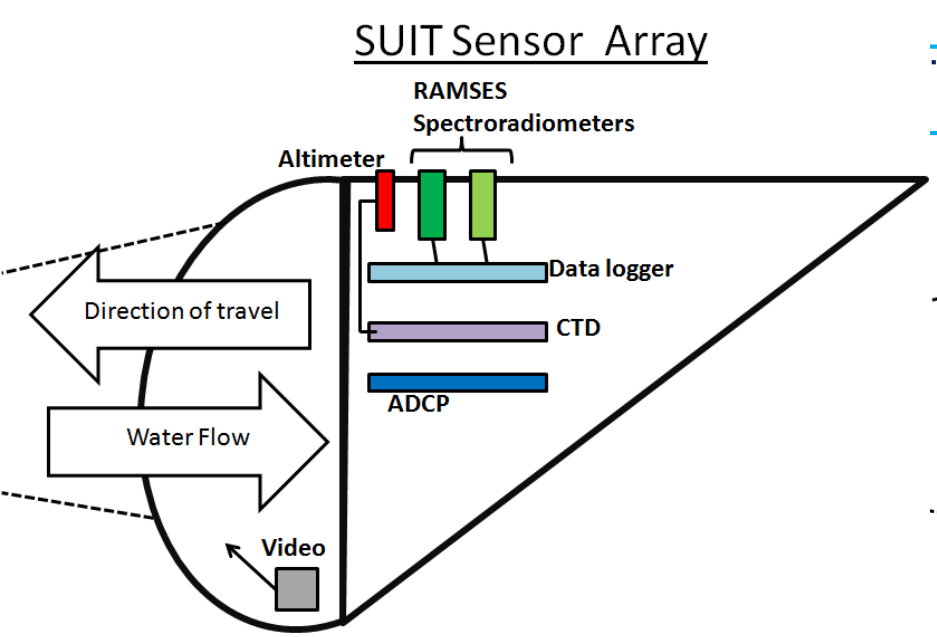


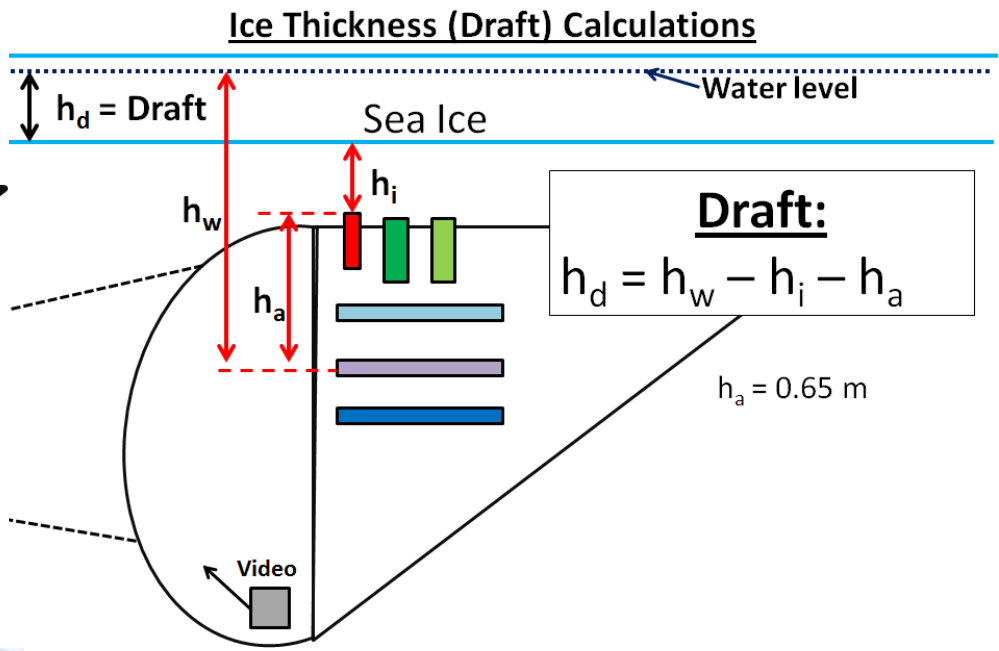
Ship (*Polarstern*)

SUIT (NTS)

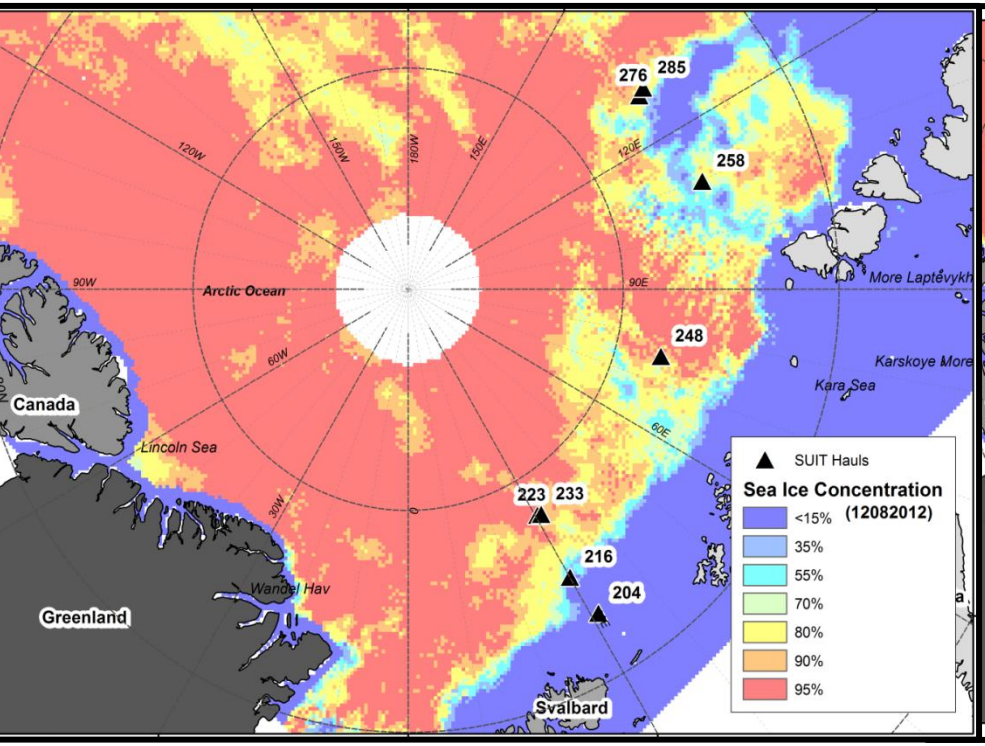


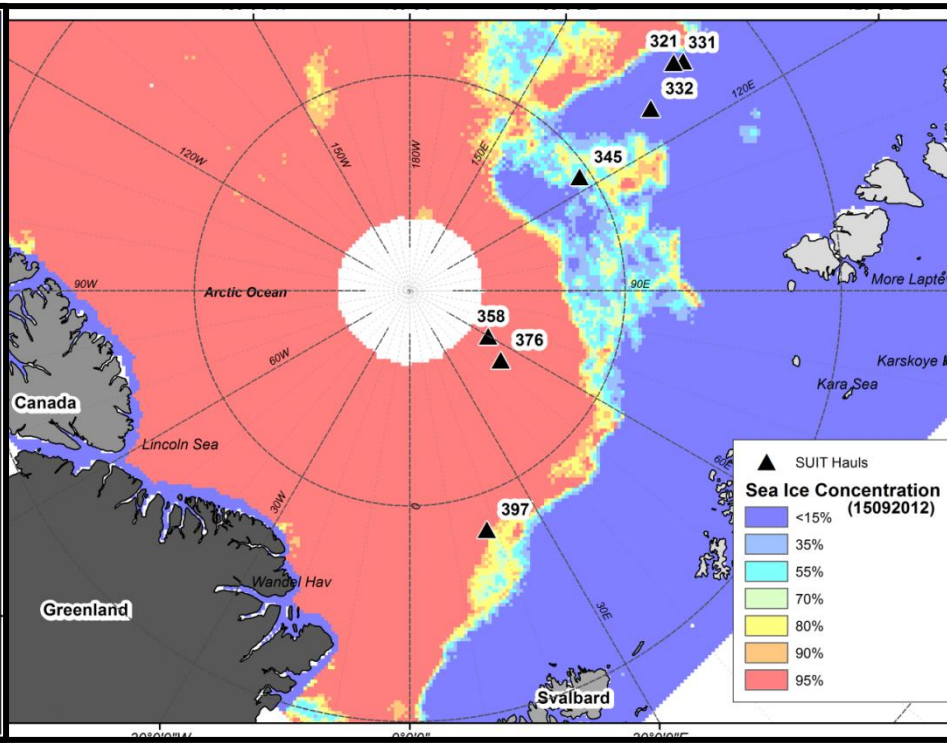
Surface and Under-Ice Trawl (SUIT)





SUIT Haul locations





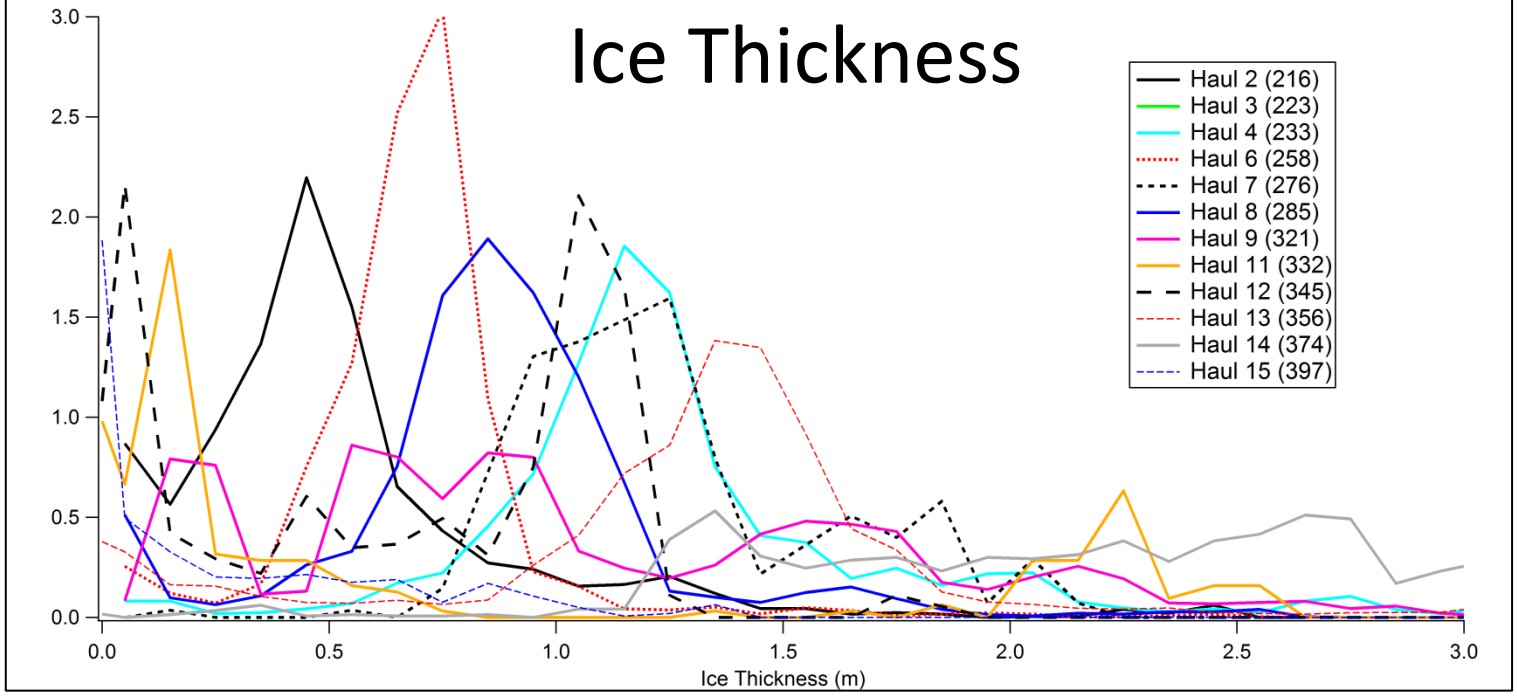
- SUIT Hauls btw Aug 5-26, 2012
- SIC data acquired Aug 12*

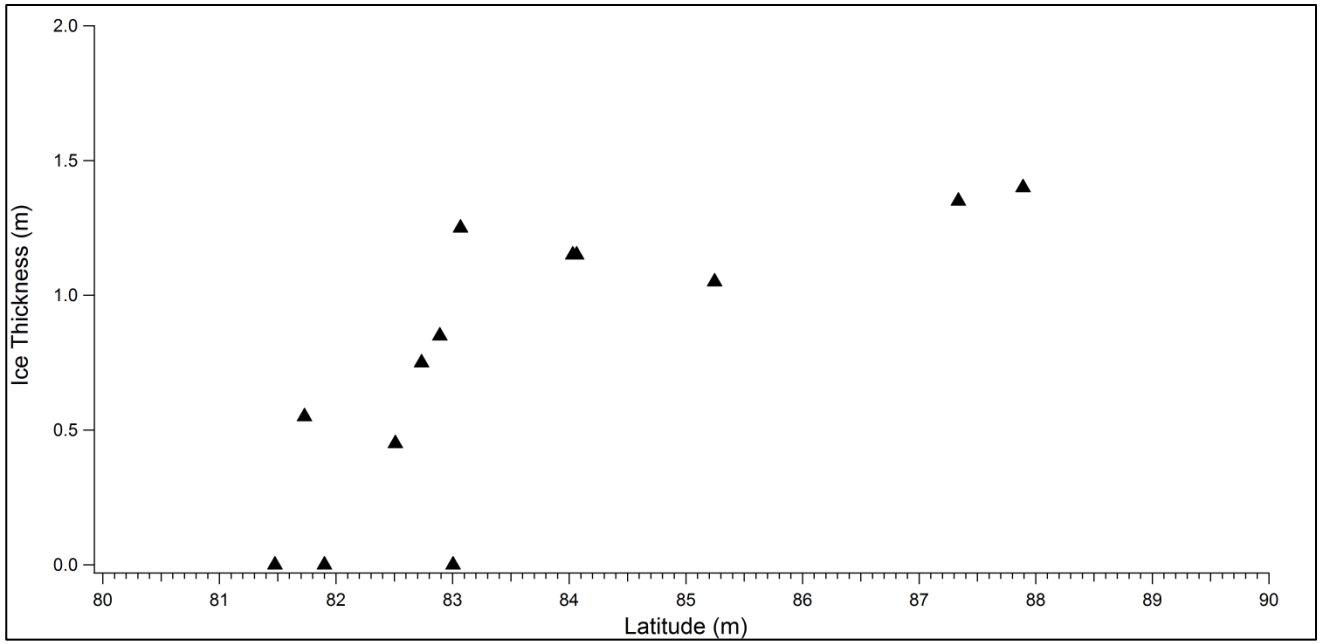
- SUIT Hauls btw Sept 4-29, 2012
- SIC data acquired Sept 15 *

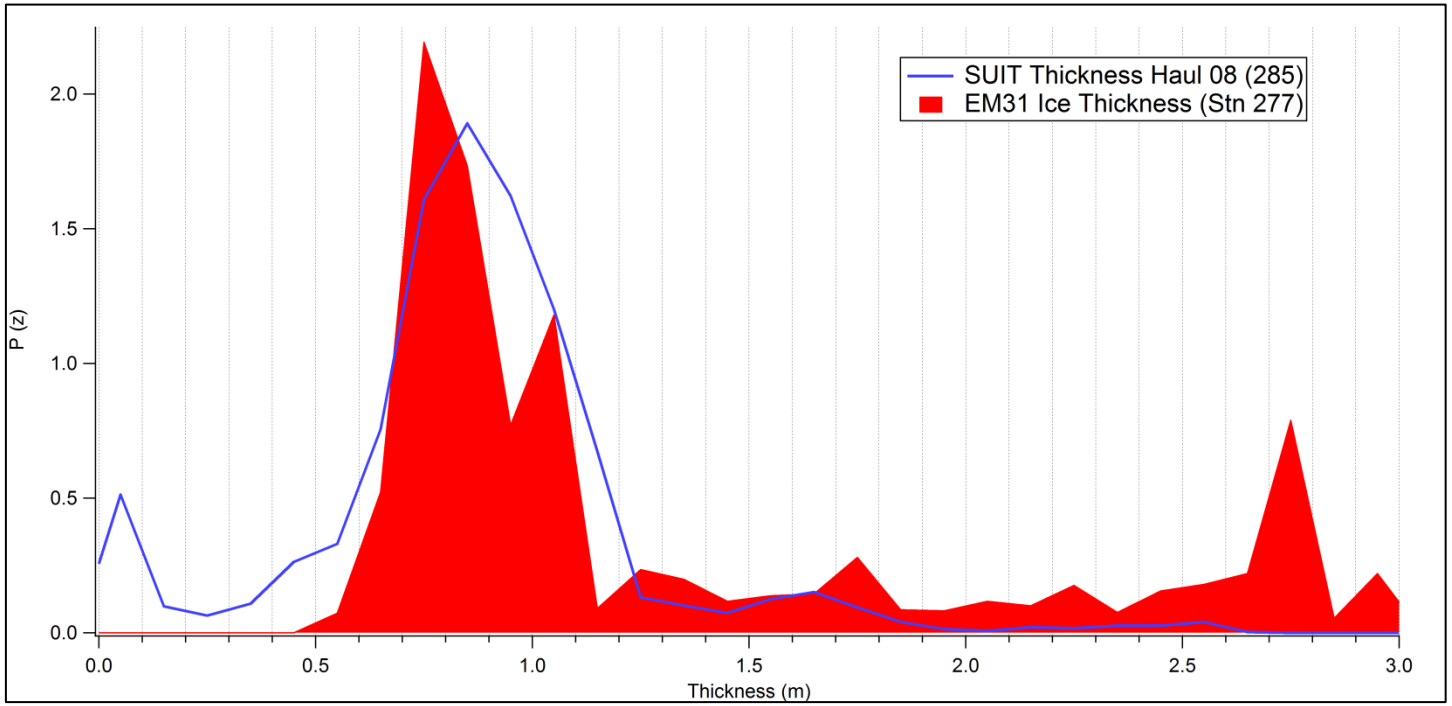
*Sea ice concentration data courtesy Bremen University

Observations

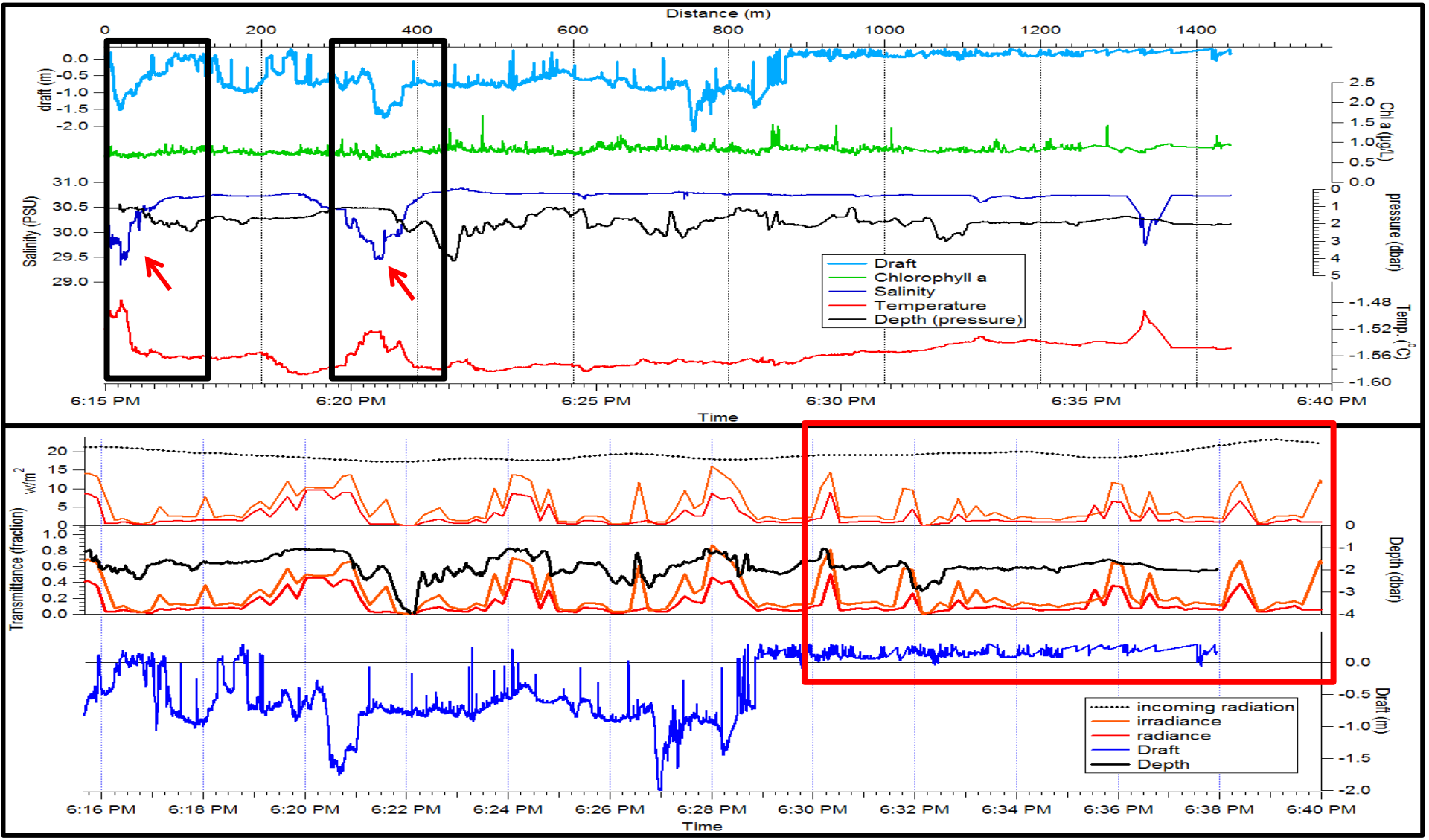
- Multi spectral light observations
  - Incoming; under-ice radiance & irradiance; transmittance
- Sea ice draft (thickness)
- CTD observations
  - Chl a, temp., salinity, depth,
- ADCP
  - water volume coverage; pitch & roll
- Catch data
  - Species level count, size, sex and biomass


Ice Thickness
Haul 2 (216)
Haul 3 (223)
Haul 4 (233)
Haul 6 (258)
Haul 7 (276)
Haul 8 (285)
Haul 9 (321)
Haul 11 (332)
Haul 12 (345)
Haul 13 (356)
Haul 14 (374)
Haul 15 (397)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Ice Thickness (m)


2.0
1.5
1.0
0.5
0.0
Ice Thickness (m)
80
81
82
83
84
85
86
87
88
89
90
Latitude (m)

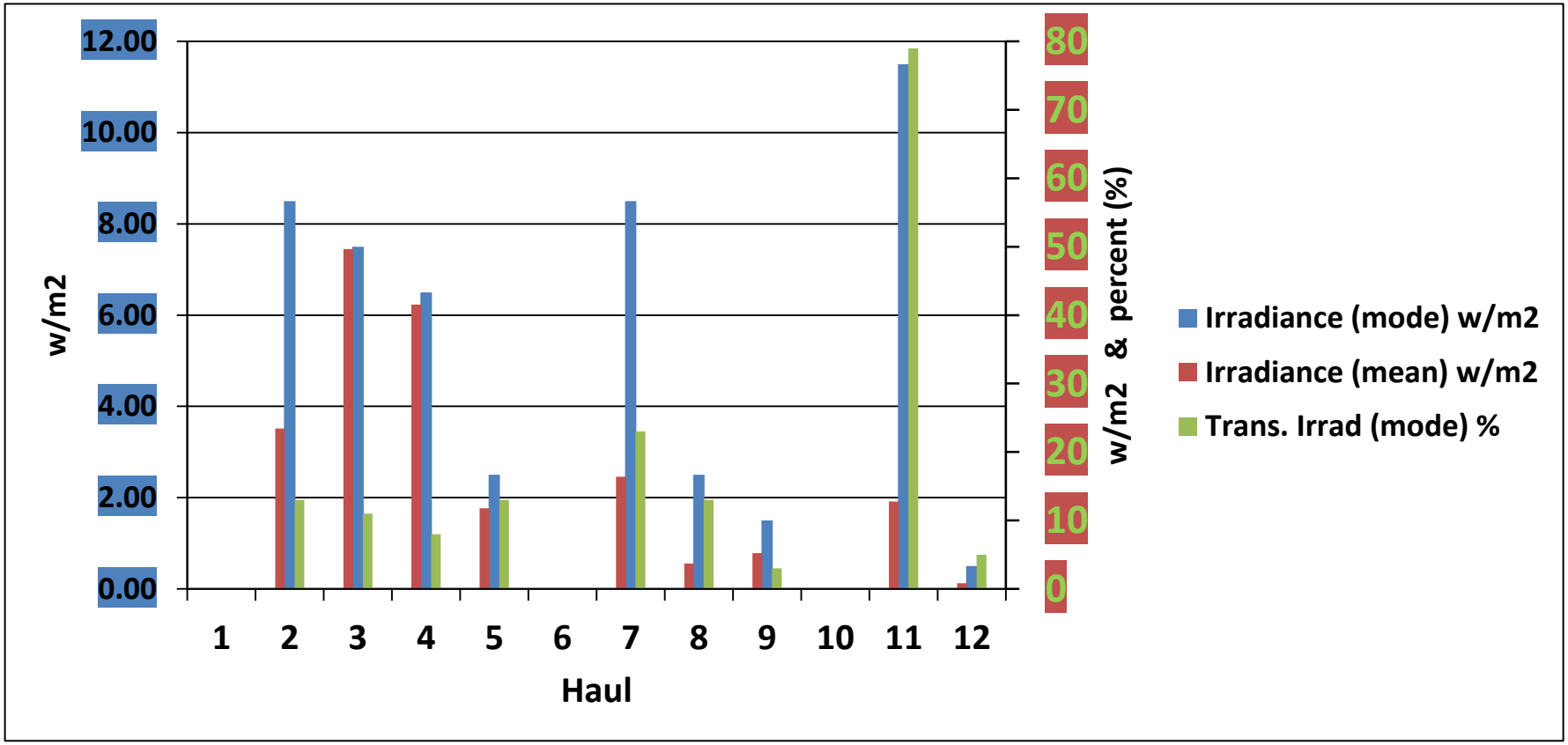


- Ice thickness data validation:
  - SUIT thickness distribution compared to EM31 ice thickness survey of nearby ice station

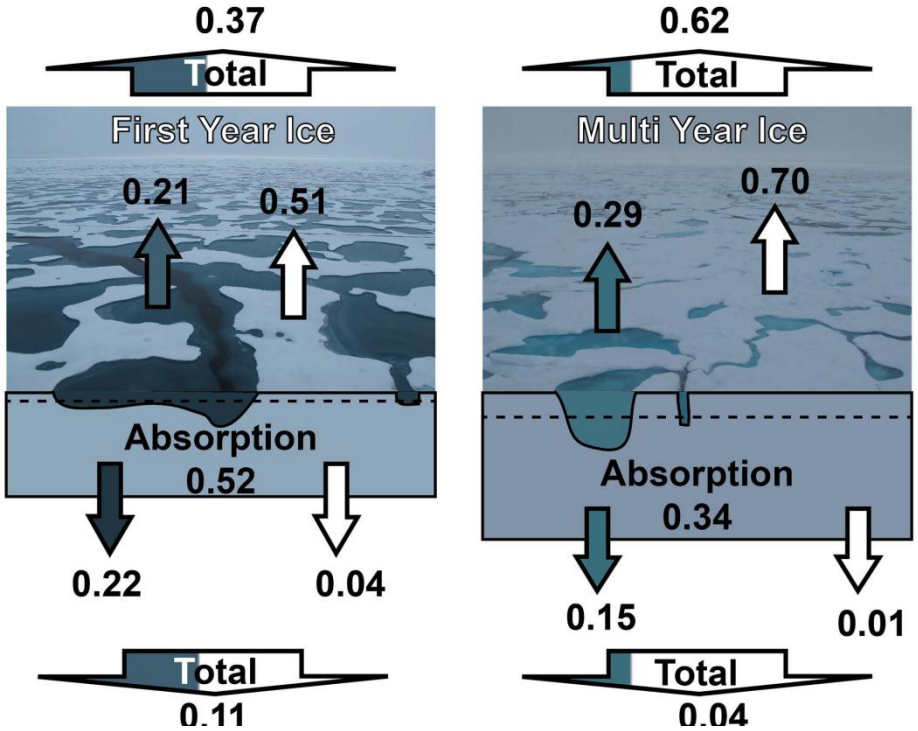


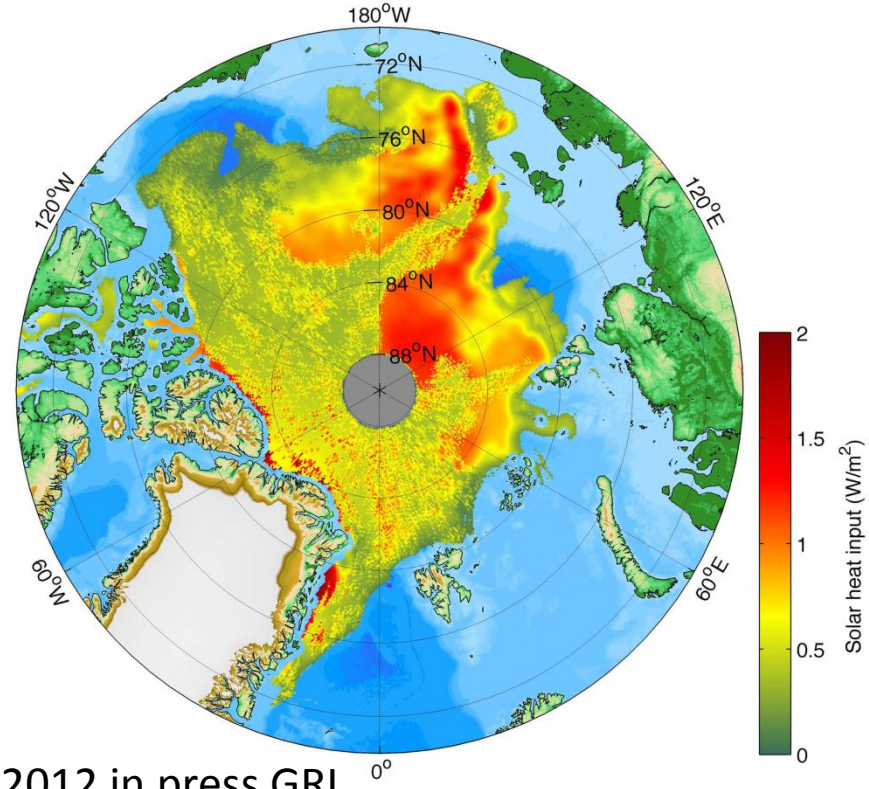
- Multi-data profiles for Haul 08 (stn 285)

Under-ice Irradiance observations



- Irradiance and radiance are integrated over spectral range 350-920 nm
- Transmitted Irradiance varied between **3 – 23** % (0.03 - 0.23)
- Under-ice modal Irradiance **0.5 – 8.5** w/m^2 mean **0.84 – 49.6** w/m^2



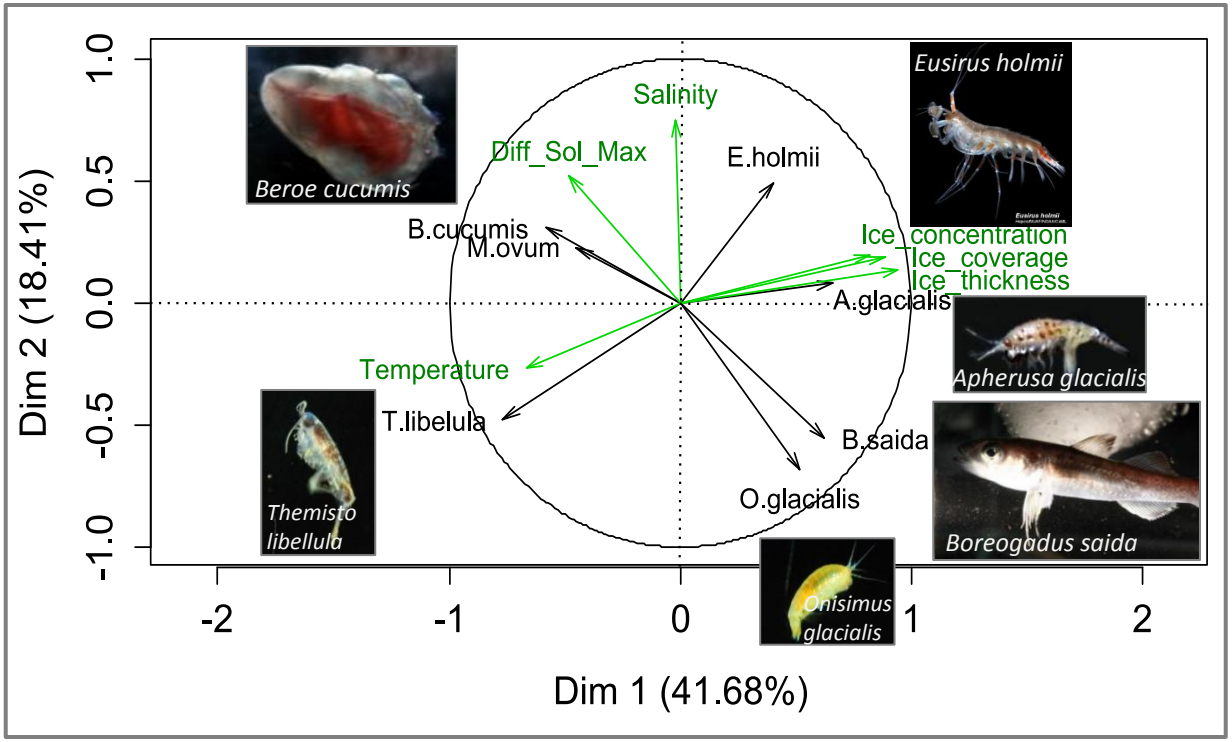


Nicolaus et al., 2012 in press GRL

- Nicolaus et al. (2012 in press) showed increased light transmittance due to more FYI
- This work continued during *Icearc* 2012
- SUIT light transmittance data will complement ROV work and expand coverage to provide insight into 2012 record minimum SIE

Exploratory Statistics

- Association of sea ice properties (thickness) with sympagic amphipods and polar cod and inversely correlated with association of water temperature and the amphipod *T.libellula*
- *B.saida* and *O.glacialis* are inversely correlated with salinity
- Positive association of the ctenophores (*B.cucumis* and *M.ovum*) with light intensity



Principal Component Analysis on representative species in ARK27/3 samples and physical parameters describing the habitats; Variables map presented as correlation circle with the first two dimensions explaining 60% of variability in the dataset

Summary and Conclusions

- SUIT sensor array provide accurate and representative data for characterizing the sea ice and under-ice habitats
- Ice Thickness demonstrated increasing trend with Latitude (varied btw 0.45 – 1.4 m)
- Light transmittance varied between 0.03 – 0.23
- Light data may contribute to understanding energy budget and 2012 record minimum sea ice extent
- Spectral data will be used to further explore the in-ice biology by expanding on ice algae spectral model developed by Mundy et al. (2007)
- Association between sea ice thickness and sympagic amphipods and polar cod

Acknowledgements:

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- Sea ice physics and biology groups during the IceArc cruise

Institutes

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- IMARES
- Hamburg University
- Helmholtz Association